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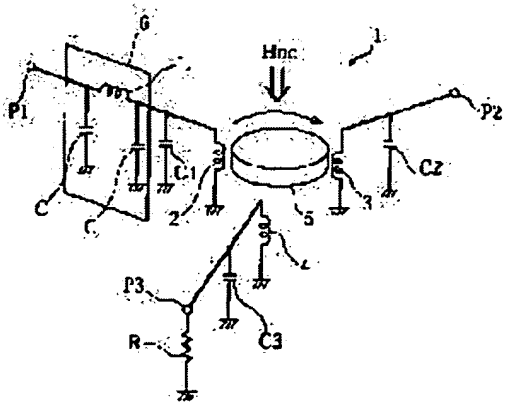
(54) IRREVERSIBLE CIRCUIT ELEMENT AND COMPOSITE ELECTRONIC COMPONENT

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an irreversible circuit element which eliminates increase in a loss and a narrow frequency band in the case of setting to a low power supply voltage.

SOLUTION: Relating to an isolator (irreversible circuit element) where plural center electrodes 2-4 are placed in crossing, a ferrite 5 is placed at the crossing part and a DC magnetic field HDC is applied to the ferrite 5, an impedance converter 6 is added to any of ports P1 of the center electrodes 2-4 to set an impedance Zi to be 2<Zi<12.5 ohms.



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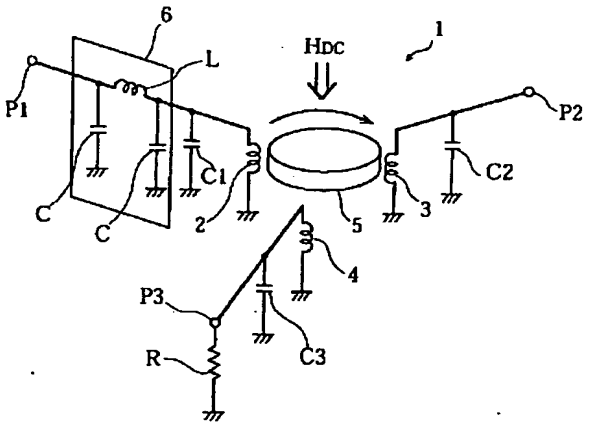
(54)【発明の名称】非可逆回路素子及び複合電子部品

(57)【要約】

【課題】　低電源電圧に設定する場合の損失の増大，及び周波数の狭帯域を回避できる非可逆回路素子を提供する。

【解決手段】　複数の中心電極２～４を交差させて配置し、該交差部分にフェライト５を配置するとともに直流磁界HDCを印加するようにしたアイソレータ１（非可逆回路素子）において、上記中心電極２～４の何れか１つのポートＰ１にインピーダンス変換回路６を付加し、入力インピーダンスＺｉを２＜Ｚｉ＜１２．５Ωに設定する。



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【特許請求の範囲】

【請求項１】　複数の中心電極を交差させて配置し、該交差部分にフェライトを配置するとともに直流磁界を印加するようにした非可逆回路素子において、上記中心電極の何れか１つのポートの入力及び出力インピーダンスＺｉｏを２＜Ｚｉｏ＜１２．５Ωに設定したことを特徴とする非可逆回路素子。

【請求項２】　複数の中心電極を交差させて配置し、該交差部分にフェライトを配置するとともに直流磁界を印加するようにした非可逆回路素子において、上記中心電極の何れか１つのポートにインピーダンス変換回路を付加し、該ポートの入力インピーダンスＺｉを２＜Ｚｉ＜１２．５Ωに設定したことを特徴とする非可逆回路素子。

【請求項３】　請求項２において、上記インピーダンス変換回路が付加されていない残りのポートの１つに終端抵抗を接続してアイソレータとしたことを特徴とする非可逆回路素子。

【請求項４】　請求項２又は３において、上記インピーダンス変換回路が、Ｃ－Ｌ－Ｃのπ型回路網により構成されていることを特徴とする非可逆回路素子。

【請求項５】　請求項４において、上記Ｃ－Ｌ－Ｃのπ型回路網のカットオフ周波数ｆｃが０．７５×ｆｏ＜ｆｃ＜２×ｆｏとなるように設定されていることを特徴とする非可逆回路素子。

【請求項６】　請求項２又は３において、上記インピーダンス変換回路が、Ｌ－Ｃ－Ｌのπ型回路網により構成されていることを特徴とする非可逆回路素子。

【請求項７】　請求項２又は３において、上記インピーダンス変換回路が、（２ｎ－１）・λｇ／４（ｎは自然数，λｇは線路内波長）の分布定数トランスにより構成されていることを特徴とする非可逆回路素子。

【請求項８】　磁気回路を構成するヨーク内に、複数の中心電極を交差させて配置するとともに該交差部分にフェライトを配置してなる磁性組立体と、上記各中心電極のポートに接続された整合用コンデンサとを収納した非可逆回路素子において、上記中心電極の何れか１つのポートにインピーダンス変換回路を付加するとともに上記ヨーク内に内蔵し、該ポートの入力インピーダンスＺｉを２＜Ｚｉ＜１２．５Ωに設定したことを特徴とする非可逆回路素子。

【請求項９】　請求項８において、上記インピーダンス変換回路が、ヨーク内に配設された非可逆回路構成部品に形成されていることを特徴とする非可逆回路素子。

【請求項１０】　請求項１ないし９の何れかの非可逆回路素子を送信電力増幅器の出力部に接続して１つのケース内に収納し、表面実装用端子を有し、かつ６ボルト以下の電源電圧で動作することを特徴とする複合電子部品。

【発明の詳細な説明】

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【０００１】

【発明の属する技術分野】本発明は、マイクロ波帯で使用される非可逆回路素子、例えば集中定数型のアイソレータ，サーキュレータに関する。

【０００２】

【従来の技術】最近、携帯電話機等の移動通信機器の分野では、１／４πＱＰＳＫやＣＤＭＡといった帯域利用効率の高いディジタル変調方式を採用した通信機器が採用されつつある。このディジタル通信機器においては、図９に示すように、送信電力増幅部に線形増幅器２０が採用されている。これは入力整合回路２１，１段目増幅素子２２，段間整合回路２３，２段目増幅素子２４，出力整合回路２５を接続配置した構造となっている。

【０００３】このような線形増幅器２０を採用するにあたっては、電力増幅部での電力消費量が電池動作による携帯電話機の通信可能時間に大きな影響を与えることから、高効率化を図る上での技術改良が著しく進んでいる。

【０００４】ところで、上記高効率線形増幅器は、負荷インピーダンスの変化の影響を受け易い特性を持っている。即ち、増幅の高効率化は負荷インピーダンスが望ましい値で一定の場合にのみ発揮される。例えば、アンテナのように入力インピーダンスの変化が大きい負荷を上記線形増幅器に直接接続すると、増幅器の効率が低下したり，入出力線形性が劣化したりするという問題が生じる。その結果、送信電力増幅部での電力消費量が増加して電池の放電が進み通信可能時間が短くなったり、また送信波に歪みが生じ、隣接チャンネル・隣接周波数に妨害波を発生してしまう場合がある。さらに変調歪みのために受信側で復調不能となって送信そのものができなくなるおそれがある。

【０００５】このような問題を解消するために、上記線形増幅器２０とアンテナ２６との間に集中定数型のアイソレータ２７を挿入する場合がある。このアイソレータは、図８に示すように、３つの中心電極３０～３２を互いに所定間隔ごとに交差させて配置し、該交差部分にフェライト３３を配置するとともに、直流磁界ＨＤＣを印加するように構成されており、上記中心電極３２のポートＰ３に終端抵抗Ｒが接続されている。

【０００６】上記アイソレータ２７は負荷インピーダンスの変化にかかわらず入力インピーダンスが安定であることから、アンテナからの反射を吸収して整合状態を改善する機能を有している。これにより上記線形増幅器の効率の低下，あるいは入出力線形性の劣化を防止している。また上記線形増幅器２０の入力及び出力の特性インピーダンスは５０Ωで設計するのが一般的であり、アイソレータ２７においても入力インピーダンスは一般に５０Ωに設定されており、これは高周波部品における標準値となっている。

【０００７】一方、上記携帯電話機の小型化，軽量化に

伴って電池構成の簡略化も進んでおり、最近では３．６～６Ｖ程度の電圧に設定される場合がある。このため線形増幅器の電源電圧も３．０～６Ｖ程度に設定されている。また上記線形増幅器の飽和電力（入力を増加してもこれ以上出力の増えない電力をいう）は、電源電圧と増幅素子（トランジスタ，電界効果トランジスタ，その中でも最近は特にＧａＡｓ－ＦＥＴ）の出力インピーダンスで決定され、例えば定格出力電力が１Ｗ程度の線形電力増幅器では飽和電力は余裕を持たせるために２Ｗ前後に設定するのが一般的である。

【０００８】

【発明が解決しようとする課題】ところが、上記低電源電圧とした場合、図９に示すように、出力増幅素子２４の出力インピーダンスＺｏは２～６Ω程度となり、通常の５０Ωに設定される線形増幅器の出力インピーダンスに比べてかなり低くなる。このような低いインピーダンスを５０Ωに変換するには、インピーダンス変換比の大きい出力整合回路２５を採用する必要があり、このため変換回路における損失が増加するとともに良好な整合がなされる周波数範囲が狭くなる。その結果、電力増幅器の効率，動作周波数帯域を劣化させる要因になるという問題がある。

【０００９】本発明は、上記実情に鑑みてなされたもので、低電源電圧に設定する場合の損失の増大，及び周波数の狭帯域を回避でき、小型化，低価格化に貢献できる非可逆回路素子及び複合電子部品を提供することを目的としている。

【００１０】

【課題を解決するための手段】請求項１の発明は、複数の中心電極を交差させて配置し、該交差部分にフェライトを配置するとともに直流磁界を印加するようにした非可逆回路素子において、上記中心電極の何れか１つのポートの入力及び出力インピーダンスＺｉｏを２＜Ｚｉｏ＜１２．５Ωに設定したことを特徴としている。

【００１１】請求項２の発明は、請求項１と同様の非可逆回路素子において、上記中心電極の何れか１つのポートにインピーダンス変換回路を付加し、該ポートの入力インピーダンスＺｉを２＜Ｚｉ＜１２．５Ωに設定したことを特徴としている。

【００１２】請求項３の発明は、請求項２において、上記インピーダンス変換回路が付加されていない残りのポートの１つに終端抵抗を接続してアイソレータとしたことを特徴としている。

【００１３】請求項４の発明は、請求項２又は３において、上記インピーダンス変換回路が、Ｃ－Ｌ－Ｃのπ型回路網により構成されていることを特徴としている。

【００１４】請求項５の発明は、請求項４において、上記Ｃ－Ｌ－Ｃのπ型回路網のカットオフ周波数ｆｃが０．７５×ｆｏ＜ｆｃ＜２×ｆｏとなるように設定されていることを特徴としている。

【００１５】請求項６の発明は、請求項２又は３において、上記インピーダンス変換回路が、Ｌ－Ｃ－Ｌのπ型回路網により構成されていることを特徴としている。

【００１６】請求項７の発明は、請求項２又は３において、上記インピーダンス変換回路が、（２ｎ－１）・λｇ／４（ｎは自然数，λｇは線路内波長）の分布定数トランスに構成されていることを特徴としている。

【００１７】請求項８の発明は、磁気回路を構成するヨーク内に、複数の中心電極を交差させて配置するとともに該交差部分にフェライトを配置してなる磁性組立体と、上記各中心電極のポートに接続された整合用コンデンサとを収納した非可逆回路素子において、上記中心電極の何れか１つのポートにインピーダンス変換回路を付加するとともに上記ヨーク内に内蔵し、該ポートの入力インピーダンスＺｉを２＜Ｚｉ＜１２．５Ωに設定したことを特徴としている。

【００１８】請求項９の発明は、請求項８において、上記インピーダンス変換回路が、ヨーク内に配設された非可逆回路構成部品に形成されていることを特徴としている。

【００１９】請求項１０の発明は、請求項１ないし９の何れかの非可逆回路素子を送信電力増幅器の出力部に接続して１つのケース内に収納し、表面実装用端子を有し、かつ６ボルト以下の電源電圧で動作することを特徴とする複合電子部品。

【００２０】ここで、上記入力インピーダンスＺｉとは、アイソレータの入力ポートのように、当該ポートが電力を受けることをその機能として通常期待されるポートの特性インピーダンスの意味であり、出力インピーダンスＺｏとは、増幅器の出力ポートのように当該ポートが電力を送り出すことをその機能として通常期待されるポートの特性インピーダンスの意味であり、さらに入力及び出力インピーダンスＺｉｏとは、サーキュレータの入出力ポートのように当該ポートが電力を受けること及び送り出すことを共にその機能として通常期待されるポートの特性インピーダンスの意味である。

【００２１】

【発明の実施の形態】以下、本発明の実施の形態を添付図面に基づいて説明する。図１及び図２は、請求項１，２，３，４，５の発明の一実施形態によるアイソレータを説明するための図であり、図１はアイソレータの等価回路図、図２は本アイソレータが採用された携帯電話用送信電力増幅器の構成図である。

【００２２】本実施形態の集中定数型アイソレータ１は、３つの中心電極２，３，４を互いに電機的絶縁状態にかつ所定角度をなすように交差させて配置し、該交差部分にフェライト５を配置するとともに、永久磁石（不図示）により直流磁界ＨＤＣを印加して構成されている。

【００２３】上記各中心電極２～４と各ポートＰ１～Ｐ３との間には整合用容量Ｃ１～Ｃ３が並列接続されてお

り、このうち１つのポートＰ３には終端抵抗器Ｒが接続されている。これによりポートＰ１からの送信信号をポートＰ２に伝送し、該ポートＰ２から侵入する反射波を終端抵抗器Ｒで吸収する。

【００２４】そして上記ポートＰ１にはインピーダンス変換回路６が付加されている。このインピーダンス変換回路６により上記ポートＰ１のインピーダンスのみ２～１２．５Ωに設定されており、ポートＰ２のインピーダンスは５０Ωに設定されている。上記インピーダンス変換回路６はアイソレータ１内に一体に内蔵されている。

【００２５】上記インピーダンス変換回路６は、インダクタンスＬとキャパシタＣとのＣ－Ｌ－Ｃπ型回路網からなるもので、このπ型回路網のカットオフ周波数ｆｃは０．７５×ｆｏ＜ｆｃ＜２×ｆｏの範囲となるように設定されている。

【００２６】また上記アイソレータ１は、送信電力増幅器１０とアンテナ１１との間に挿入されている。この電力増幅器１０は、入力整合回路１２，１段目増幅素子１３，段間整合回路１４，２段目増幅素子１５，及び出力整合回路１６を備えており、該出力整合回路１６の出力部に上記アイソレータ１が接続されている。

【００２７】次に本実施形態の作用効果について説明する。本実施形態のアイソレータ１によれば、送信信号が入力されるポートＰ１にインピーダンス変換回路６を付加し、インピーダンスを２～１２．５Ωに設定したので、出力増幅素子１５からの低いインピーダンスを安定したインピーダンスに変換することが可能となる。

【００２８】これにより、上述のインピーダンス変換比の大きい整合回路を設ける必要はなくなり、リアクタンス成分だけを除去する出力整合回路１６を採用することができる。その結果、３～６ボルトの低電源電圧に設定する場合の挿入損失を小さくできるとともに、周波数帯域を広くでき、品質に対する信頼性を向上できる。ひいては携帯電話機の小型化，軽量化に貢献できる。

【００２９】本実施形態では、インピーダンス変換回路６のカットオフ周波数ｆｃを０．７５×ｆｏ＜ｆｃ＜２×ｆｏの範囲としたので、これにより低域通過フィルタとして機能することとなり、送信電力増幅器１０で発生する不要な高調波を抑制除去でき、この点からも信頼性，高性能化に貢献できる。

【００３０】なお、上記実施形態では、集中定数型アイソレータ１を例にとって説明したが、本発明は、図３に示すように、３ポート型のサーキュレータ４０にも勿論適用でき、この場合にも何れか１つのポートＰ１にインピーダンス変換回路６を付加することにより上記実施形態と同様の効果が得られる。

【００３１】図４は、請求項６の発明の一実施形態によるサーキュレータを説明するための等価回路図であり、図中、図１と同一符号は同一又は相当部分を示す。

【００３２】本実施形態の集中定数型サーキュレータ４

１は、３つの中心電極２～４の交差部分にフェライト５を配置するとともに直流磁界HDCを印加して構成されている。そして上記サーキュレータ４１の１つのポートＰ１にはインピーダンス変換回路４２が付加されており、該インピーダンス変換回路４２はＬ－Ｃ－Ｌのπ型回路網からなるものである。

【００３３】本実施形態においても、低いインピーダンスを安定したインピーダンスに変換することが可能となり、上記実施形態と同様の効果が得られる。

【００３４】図５は、請求項７の発明の一実施形態によるサーキュレータを説明するための等価回路図であり、図中、図１と同一符号は同一又は相当部分を示す。

【００３５】本実施形態のサーキュレータ４１は１つのポートＰ１にインピーダンス変換回路４３を付加し、該変換回路４３を（２ｎ－１）・λｇ／４の分布定数トランスにより構成した場合である。本実施形態においても、上記実施形態と同様の効果が得られる。

【００３６】図６及び図７は、請求項１０の発明の一実施形態による複合電子部品を説明するための図であり、図中、図１及び図２と同一符号は同一又は相当部分を示す。

【００３７】本実施形態のアイソレータ１は、ポートＰ１にインピーダンス変換回路６を付加してなり、基本的構造は上記実施形態と同様である。そして本アイソレータ１は６ボルト以下の電源電圧で動作する送信電力増幅器５０内に一体に内蔵されている。

【００３８】上記送信電力増幅器５０は、回路基板５１に上述の入力整合回路１２，１段目増幅素子１３，段間整合回路１４，２段目増幅素子１５，及び出力整合回路１６を実装し、各素子１２～１６をマイクロストリップライン５４により接続してなり、該出力整合回路１６の出力部に上記アイソレータ１が接続されている。

【００３９】また上記回路基板５１にはシールドケース５２が装着されており、該ケース５２と回路基板５１との間から表面実装用の入出力，及びアース端子５３が突出している。

【００４０】本実施形態では、送信電力増幅器５０内にアイソレータ１を内蔵して一体化したので、１つの複合電子部品として構成できることから、回路構成を単純化できるとともに、小型化でき、携帯電話機の小型化に貢献できる。

【００４１】ここで、近年の携帯電話機等の小型化，軽量化に伴って回路基板の薄板化が進んでおり、これに対してマイクロストリップラインのライン幅も極端に狭くなる。例えば、回路基板の板厚を０．１ｍｍとした場合の特性インピーダンス５０Ωのライン幅は０．１７ｍｍとなり、また板厚を０．３ｍｍとした場合の特性インピーダンス５０Ωのライン幅は０．５ｍｍとなる。

【００４２】このようにライン幅が狭くなると、マクイロストリップラインの幅精度が得られず整合不良を起こ

す場合があり、また半田付け用実装パッドを上記ライン幅に対して幅広とする必要があることから、該実装パッドでの整合不良を起こすという問題が生じる。さらにライン幅が狭くなるとそれだけ伝送損失も大きくなる。

【００４３】これに対して本実施形態のように特性インピーダンスを２～１２．５Ωに設定した場合には、回路基板５１の薄板化に係わらずマイクロストリップライン５４のライン幅を広くすることが可能となり、上記整合不良の問題，及び伝送損失の問題を解消できる。また半田付け用実装パッド５５を幅広にしても整合不良を起こすのを回避できるので、表面実装を行う際のアイソレータ１の位置ずれによる接続不良等の実装性の悪化を防止でき、接続強度を向上できる。

【００４４】これにより通信機器等の生産性，及び堅牢性を向上でき、ひいては安価で信頼性の高い通信機を提供できる。なお、上記マイクロストリップラインに限られるものではなく、ストリップライン線路，コプレーナ線路，グランデッド・コプレーナ線路等の伝送線路の場合にも同様である。

【００４５】また特性インピーダンス５０Ω以外の信号で変換を行う場合、上記電力増幅器５０内にアイソレータ１を内蔵したので、例えばユーザが直接非５０Ω系の箇所を扱う必要がなく、設計変更等の手間を不要にできる。

【００４６】図１０ないし図１４は、請求項８，９の発明の一実施形態による非可逆回路素子を説明するための図である。本実施形態では、上述のインピーダンス変換回路を内蔵したアイソレータの具体的構造を説明する。図中、図１と同一符号は同一又は相当部分を示す。

【００４７】図において、１は移動通信機器の送信電力増幅部に接続される集中定数型アイソレータであり、これは磁性体金属からなる箱状の上ヨーク６０の内面に矩形状の永久磁石６１を貼着するとともに、該上ヨーク６１に同じく磁性体金属からなる下ヨーク６２を装着して磁気閉回路を形成し、該下ヨーク６２の底面６２ａ上に樹脂ケース６３を配置するとともに、該樹脂ケース６３に磁性組立体６４を配置し、該磁性組立体６４に上記永久磁石６１により直流磁界を印加するように構成されている。

【００４８】上記磁性組立体６４は、円板状のフェライト５の上面に３本の中心電極２，３，４を絶縁シート（不図示）を介在させて１２０度角度ごとに交差するように折り曲げて配置し、各中心電極２～４の一端側の入出力ポートＰ１，Ｐ２，Ｐ３を外方に突出するとともに、他端側のアース部７をフェライト４の底面に当接した構造のものである。

【００４９】上記樹脂ケース６３は電気的絶縁部材からなり、矩形枠状の側壁６３ａに底壁６３ｂを一体形成した構造のもので、この底壁６３ｂには挿通孔６３ｃが形成されており、該底壁６３ｂの挿通孔６３ｃの周縁部にはそれぞれ各単板型整合用コンデンサＣ１～Ｃ３を位置決め収納する凹部６３ｄ，及び単板型終端抵抗Ｒを位置決め収納する凹部６３ｅが形成されている。上記挿通孔６３ａには磁性組立体６４が挿入されており、該磁性組立体６４のアース部７は下ヨーク６２の底面６２ａに接続されている。

【００５０】上記樹脂ケース６３の左，右側壁６３ａ外面の一端側には入出力端子６６，６７が配設されており、該各入出力端子６６，６７の延長端は底壁６３ａ上面の左，右コーナー部に露出している。左，右側壁６３ａ外面の他端側にはアース端子６８，６８が配設されており、該各アース端子６８の延長端は上記凹部６３ｄ，６３ｅの上面に露出して各コンデンサＣ１～Ｃ３，終端抵抗Ｒの下面電極に接続されている。また上記底壁６３ｂ上面の入出力端子６６，６７の中間部には金属導体片６９が配設されており、該金属導体片６９の延長端は底壁６３ｂに露出して下ヨーク６２の底面６２ａに接続されている。上記入出力端子６６，６７，アース端子６８，金属導体片６９は樹脂ケース６３内に一部をインサートモールドして形成されたものである。

【００５１】上記各整合用コンデンサＣ１～Ｃ３の上面電極には各中心電極２～４のポートＰ１～Ｐ３が接続されており、このうちポートＰ２の先端は上記入出力端子６６に、ポートＰ３の先端は終端抵抗Ｒに接続されている。

【００５２】上記磁性組立体６４と永久磁石６１との間には矩形板状のスペーサ部材７０が配設されている。このスペーサ部材７０は、ガラスエポキシ系，プラスチック系，テフロン系等のプリント基板、セラミック基板、あるいは弾性を有する液晶ポリマー等の樹脂からなるものであり、中央部には孔７０ａが形成されている。この孔７０ａは整合用コンデンサＣ１～Ｃ３や中心電極２～４を効果的に押圧するためのもので、必ずしも形成する必要はない。

【００５３】上記スペーサ部材７０は、下ヨーク６２に上ヨーク６０を嵌装すると同時に永久磁石６１を介して磁性組立体６４，樹脂ケース６３を下ヨーク６２に、各中心電極２～４のポートＰ１～Ｐ３を整合用コンデンサＣ１～Ｃ３，終端抵抗Ｒに、また該各整合用コンデンサＣ１～Ｃ３，終端抵抗Ｒを樹脂ケース６３にそれぞれ電気的，機械的に押圧固定している。これにより各構成部品同士を半田付けする際の専用治具を不要にでき作業工数の削減が可能となり、またユーザリフローにより表面実装する際のオープン不良を防止している。

【００５４】そして上記スペーサ部材７０には、図３（ａ），図３（ｂ）に示すように、Ｃ－Ｌ－Ｃのπ型回路網からなるインピーダンス変換回路６が形成されている。このインピーダンス変換回路６は、スペーサ部材７０にインダクタンス電極７１及び第１，第２コンデンサ電極７２，７３を圧着，印刷等によりパターン形成して

構成されている。なお、上記電極７１～７３はスペーサ部材内に金属片をインサートモールドして形成してもよい。ここで、図３（ａ）はスペーサ部材７０の上面に形成された電極を示す平面図であり、図３（ｂ）はスペーサ部材７０の下面に形成された電極を透視で示した平面図である。

【００５５】上記インダクタンス電極７１の一端部７１ａはスルーホール電極７４に、他端部７１ｂは上記第１コンデンサ電極７２の一端部７２ａに接続されている。この第１コンデンサ電極７２の他端部７２ｂはスルーホール電極７５に接続されている。

【００５６】上記スペーサ部材７０の下面には該部材７０を挟んで上記第１コンデンサ電極７２に対向する第２コンデンサ電極７３が形成されており、該第２コンデンサ電極７３に続いて上記他端部７１ｂと一端部７２ａとの接続部に対向する第１接続電極７６が接続形成されている。

【００５７】また上記スペーサ部材７０下面の第１コンデンサ電極７２の他端部７２ｂに対向する部分には第２接続電極７７が形成されており、両電極７２ｂ，７７は上記スルーホール電極７５により接続されている。さらに上記スペーサ部材７０下面のインダクタンス電極７１の一端部７１ａに対向する部分には第３接続電極７８が形成されており、両電極７１ａ，７８は上記スルーホール電極７４により接続されている。

【００５８】上記第１接続電極７６は金属導体片６９を介して下ヨーク６２に接続され、第２接続電極７７は一方側の入出力端子６７に接続されており、第３接続電極７８は中心電極２のポートＰ１，及び整合用コンデンサＣ１の上面電極に接続されている。

【００５９】このようにして本実施形態のアイソレータ１は、図１３，図１４の等価回路図に示すように、インダクタンス電極７１で形成されるインダクタンスＬｆは第１コンデンサ電極７２を介して中心電極２のポートＰ１と入出力端子６７との間に直列接続され、第１，第２コンデンサ電極７２，７３で形成されるコンデンサＣｆ１は入出力端子６７と金属導体片６９（アース）との間に並列接続されている。

【００６０】そして、上記ポートＰ１の整合用コンデンサＣ１は、アイソレータ本来の整合用回路として機能するコンデンサＣｏと、コンデンサＣｆ２との並列容量とで表され、このコンデンサＣｆ２とインダクタンスＬｆとコンデンサＣｆ１とでＣ－Ｌ－Ｃのインピーダンス変換回路６が構成されている。

【００６１】本実施形態によれば、ポートＰ１にインピーダンス変換回路６を付加し、該インピーダンスを２～１２．５Ωに設定したので、上述と同様に低いインピーダンスを安定したインピーダンスに変換することが可能となり、低電源電圧に設定する場合の挿入損失を小さくできるとともに、周波数帯域を広くでき、上記実施形態と同様の効果が得られる。

【００６２】上記アイソレータ１の構成部品であるスペーサ部材７０にインピーダンス変換回路６を形成したので、該インピーダンス変換回路６をアイソレータ１に内蔵でき、変換回路を別途設ける場合の部品コストの上昇，及び大型化を回避でき、ひいては移動通信機器の小型化，低価格化に貢献できる。また上記スペーサ部材７０を有効利用して形成したので、アイソレータの外形寸法が大きくなることはなく、この点からも小型化，軽量化に貢献できる。

【００６３】なお、上記実施形態では、インピーダンス変換回路をスペーサ部材に形成した場合を例にとったが、本発明はこれに限られるものではなく、ヨーク内に配設された非可逆回路を構成する他の基板，あるいは部品等にに形成すればよい。

【００６４】

【発明の効果】以上のように請求項１の発明に係る非可逆回路素子によれば、中心電極の何れか１つのポートの入力及び出力インピーダンスＺｉｏを２＜Ｚｉｏ＜１２．５Ωに設定したので、低いインピーダンスを安定したインピーダンスに変換することが可能となり、インピーダンス変換比の大きい整合回路を設ける必要はなくなることから、低電源電圧に設定する場合の挿入損失を小さくできるとともに、周波数帯域を広くでき、品質に対する信頼性を向上できる効果がある。

【００６５】請求項２の発明では、中心電極の何れか１つのポートにインピーダンス変換回路を付加し、入力インピーダンスＺｉを２＜Ｚｉ＜１２．５Ωに設定したので、上記同様に安定したインピーダンスに変換することができ、請求項１と同様の効果が得られる。

【００６６】請求項３の発明では、インピーダンス変換回路が付加されていない残りの１つのポートに終端抵抗を接続したので、アイソレータとして機能することとなり、携帯電話機の送信電力増幅器での整合状態の改善効果がある。

【００６７】請求項４の発明では、上記インピーダンス変換回路をＣ－Ｌ－Ｃのπ型回路網により構成したので、上記請求項１と同様の効果が得られる

【００６８】請求項５の発明では、上記Ｃ－Ｌ－Ｃπ型回路網のカットオフ周波数ｆｃを０．７５×ｆｏ＜ｆｃ＜２×ｆｏの範囲としたので、低域通過フィルタとして機能することとなり、送信電力増幅器で発生する不要な高調波を抑制除去でき、信頼性，高性能化に貢献できる効果がある。

【００６９】請求項６の発明では、上記インピーダンス変換回路をＬ－Ｃ－Ｌのπ型回路網により構成したので、上記請求項１と同様の効果が得られる。

【００７０】請求項７の発明では、上記インピーダンス変換回路を（２ｎ－１）・λｇ／４（ｎは自然数，λｇは線路内波長）の分布定数トランスに構成したので、上

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記請求項１と同様の効果が得られる。

【００７１】請求項８の発明では、インピーダンス変換回路をヨーク内に内蔵したので、別回路を用いる場合のコスト上昇及び大型化を回避でき、小型化，低価格化に貢献できる効果がある。

【００７２】請求項９の発明では、インピーダンス変換回路をヨーク内に配設された非可逆回路構成部品に形成したので、該部品を有効利用して形成でき、小型化，軽量化に貢献できる効果がある。

【００７３】請求項１０の発明では、６ボルト以下の電源電圧で動作する送信電力増幅器内に非可逆回路素子を一体に内蔵したので、回路構成を簡単にできるとともに、小型化に貢献できる効果があり、またライン幅を広く設定でき、整合不良の発生を防止できる効果がある。

【図面の簡単な説明】

【図１】請求項１～５の発明の一実施形態による集中定数型アイソレータの等価回路図である。

【図２】上記アイソレータが採用された送信電力増幅器の構成図である。

【図３】サーキュレータに適用した場合の等価回路図である。

【図４】請求項６の発明の一実施形態による集中定数型サーキュレータの等価回路図である。

【図５】請求項７の発明の一実施形態による集中定数型サーキュレータの等価回路図である。

【図６】請求項１０の発明の一実施形態によるアイソレータを内蔵した送信電力増幅器（複合電子部品）の構成図である。

【図７】上記送信電力増幅器の分解斜視図である。

【図８】一般的なアイソレータの等価回路図である。

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【図９】一般的な送信電力増幅器の構成図である。

【図１０】請求項８，９の発明による集中定数型アイソレータの分解斜視図である。

【図１１】上記アイソレータの樹脂ケースの平面図である。

【図１２】上記アイソレータのスペーサ部材の平面図である。

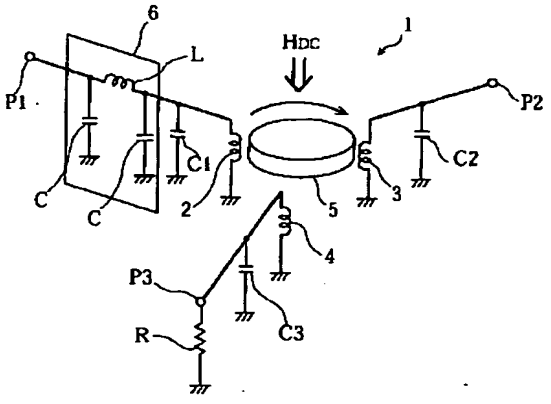
【図１３】上記アイソレータの等価回路図である。

【図１４】上記アイソレータの低域通過フィルタ部分の回路図である。

【符号の説明】

１	アイソレータ（非可逆回路素子）
２～４	中心電極
５	フェライト
６，４２，４３	インピーダンス変換回路
４０，４１	サーキュレータ（非可逆回路素子）
５０	送信電力増幅器
６０，６２	上，下ヨーク
６１	永久磁石
６４	磁性組立体
７０	スペーサ部材（非可逆回路構成部品）
７１	インダクタンス電極（インダクタンスＬｆ）
７２，７３	コンデンサ電極（コンデンサＣｆ１）
Ｐ１～Ｐ３	ポート
Ｃ１～Ｃ３	整合用コンデンサ

【図１】



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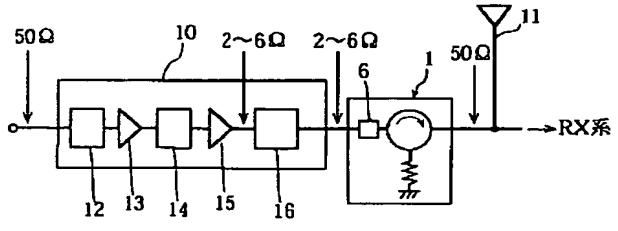

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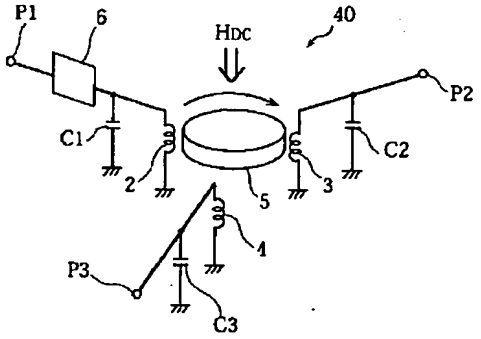

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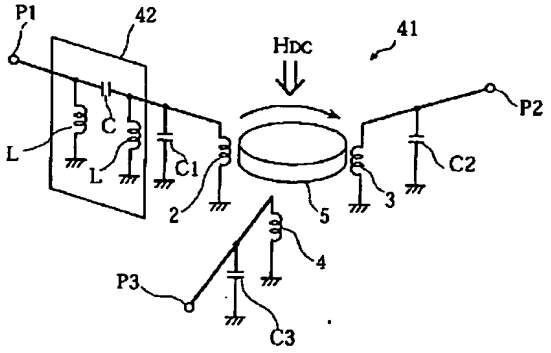

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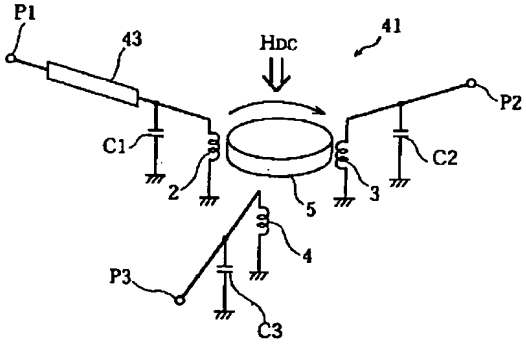

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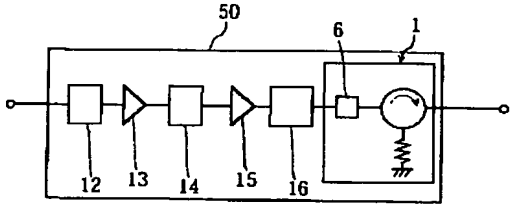

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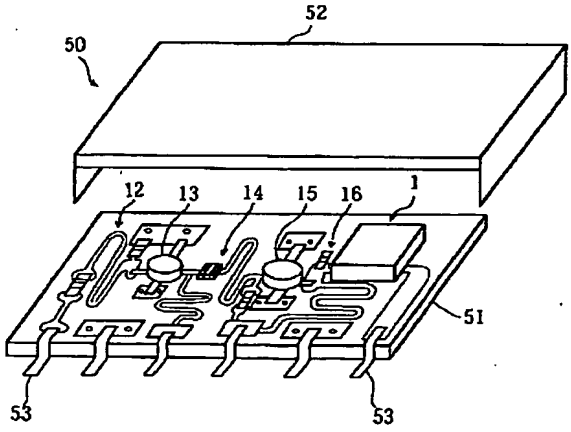

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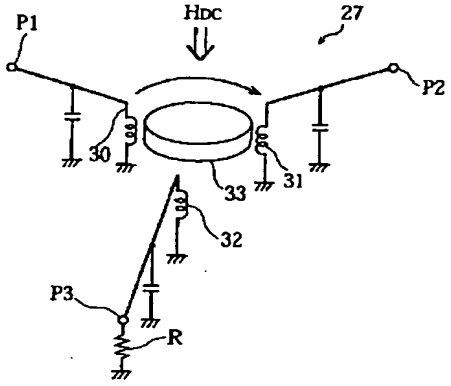

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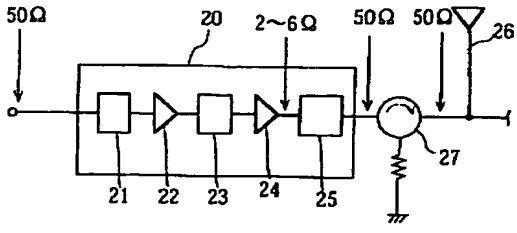

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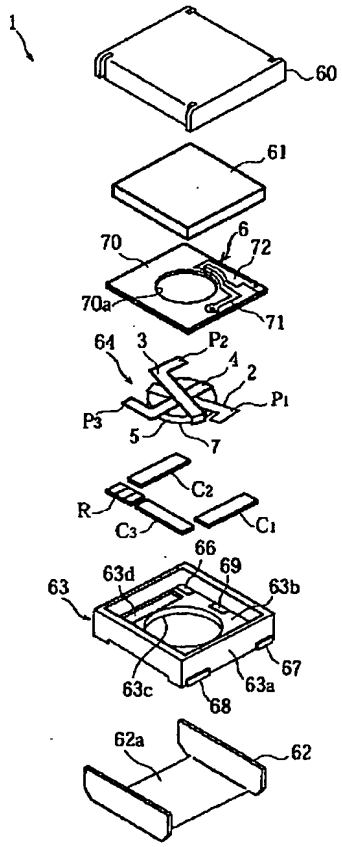

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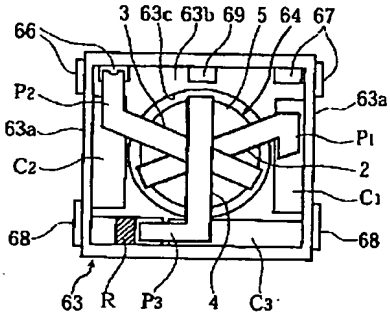

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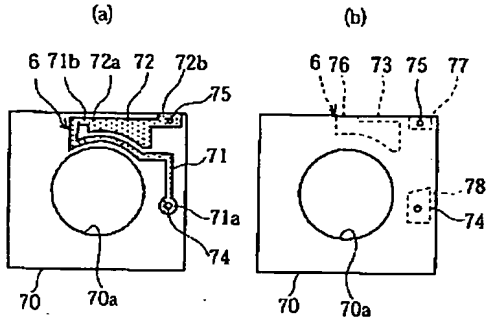

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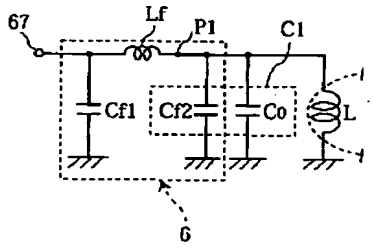

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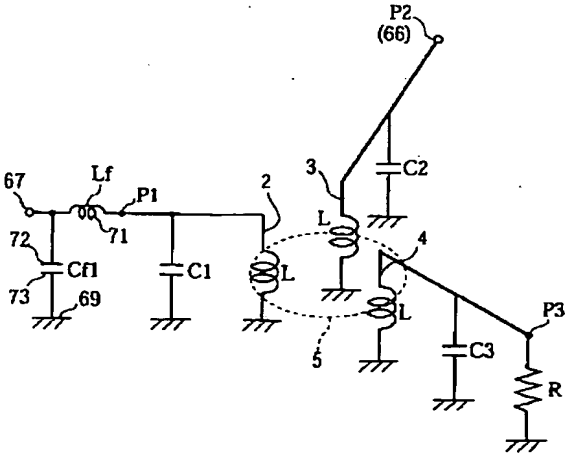

フロントページの続き

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* NOTICES *

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3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The non-reciprocal circuit component characterized by setting the input and output impedance Zio of any one port of the above-mentioned center electrode as 2<Zio<12.5ohm in the non-reciprocal circuit component it was made to impress a direct-current field while making two or more center electrodes cross, having arranged and having arranged the ferrite to a part for this intersection.
[Claim 2] The non-reciprocal circuit component characterized by having added the impedance-conversion circuit to any one port of the above-mentioned center electrode in the non-reciprocal circuit component it was made to impress a direct-current field while making two or more center electrodes cross, having arranged and having arranged the ferrite to a part for this intersection, and setting the input impedance Zi of this port as 2<Zi<12.5ohm.
[Claim 3] The non-reciprocal circuit component characterized by having connected the terminator to one of the remaining ports where the above-mentioned impedance-conversion circuit is not added in claim 2, and considering as an isolator.
[Claim 4] The non-reciprocal circuit component to which the above-mentioned impedance-conversion circuit is characterized by being constituted by pi mold network of C-L-C in claim 2 or 3.
[Claim 5] The non-reciprocal circuit component characterized by being set up in claim 4 so that the cut off frequency fc of pi mold network of above-mentioned C-L-C may serve as 0.75xfo<fc<2xfo.
[Claim 6] The non-reciprocal circuit component to which the above-mentioned impedance-conversion circuit is characterized by being constituted by pi mold network of L-C-L in claim 2 or 3.
[Claim 7] The non-reciprocal circuit component to which the above-mentioned impedance-conversion circuit is characterized by being constituted by the distributed constant transformer of -(2n-1) lambdag / 4 (n is the natural number and lambdag is the wavelength within a track) in claim 2 or 3.
[Claim 8] The magnetic assembly which comes to arrange a ferrite to a part for this intersection while making two or more center electrodes cross in York which constitutes a magnetic circuit and arranging, In the non-reciprocal circuit component which contained the capacitor for adjustment connected to the port of each above-mentioned center electrode The non-reciprocal circuit component characterized by having built in above-mentioned York while adding the impedance-conversion circuit to any one port of the above-mentioned center electrode, and setting the input impedance Zi of this port as 2<Zi<12.5ohm.
[Claim 9] The non-reciprocal circuit component characterized by forming the above-mentioned impedance-conversion circuit in the non-reciprocal circuit component part arranged in York in claim 8.
[Claim 10] Compound electronic parts characterized by connecting claim 1 thru/or which non-reciprocal circuit component of 9 to the output section of transmitted power amplifier, containing in one case, and having a terminal for surface mounts, and operating with the supply voltage of 6 volts or less.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the isolator of the non-reciprocal circuit component used with a microwave band, for example, a concentrated-constant mold, and a circulator.
[0002]
[Description of the Prior Art] Recently, in the field of migration communication equipment, such as a portable telephone, the communication equipment which adopted the digital modulation method with high band use effectiveness, such as 1/4piQPSK, and CDMA, is being adopted. In this digital communication device, as shown in drawing 9 , the linear amplifier 20 is adopted as the transmitted power amplification section. This has structure which carried out connecting arrangement of input matching circuit [the 21 or 1st step of] amplifier 22, interstage matching circuit [the 23 or 2nd step of] amplifier 24, and the output matching circuit 25.
[0003] If in charge of adopting such a linear amplifier 20, since it has effect to the time amount of the portable telephone by cell actuation which can be communicated with the big power consumption in the power amplification section, technical amelioration when attaining efficient-ization is progressing remarkably.
[0004] By the way, the above-mentioned efficient linear amplifier has the property of being easy to be influenced of change by load impedance. Namely, only in a fixed case, efficient-ization of magnification is demonstrated with a value with desirable load impedance. For example, if change of an input impedance carries out direct continuation of the large load to the above-mentioned linear amplifier like an antenna, the problem that the effectiveness of amplifier falls or I/O linearity deteriorates will arise. Consequently, the power consumption in the transmitted power amplification section increases, discharge of a cell may progress, the time amount which can be communicated may become short, and distortion may arise in a transmission wave, and an interference may be generated in an adjacent channel and a contiguity frequency. There is a possibility that may become recovery impossible by the receiving side and the transmission itself may furthermore become impossible for modulation distortion.
[0005] In order to solve such a problem, the isolator 27 of a concentrated-constant mold may be inserted between the above-mentioned linear amplifier 20 and an antenna 26. As shown in drawing 8 , while this isolator makes three center electrodes 30-32 cross for every predetermined spacing mutually, is arranged and arranges a ferrite 33 to a part for this intersection, it is constituted so that the direct-current field HDC may be impressed, and Terminator R is connected to the port P3 of the above-mentioned center electrode 32.
[0006] Since the input impedance is stable irrespective of change of load impedance, the above-mentioned isolator 27 has the function to absorb the reflection from an antenna and to improve an adjustment condition. This has prevented the decline in the effectiveness of the above-mentioned linear amplifier, or degradation of I/O linearity. Moreover, as for the characteristic impedance of the input of the above-mentioned linear amplifier 20, and an output, designing by 50 ohms is common, also in the isolator 27, generally the input impedance is set as 50 ohms, and this serves as a certified value in RF components.
[0007] On the other hand, simplification of a cell configuration is also progressing with the miniaturization of the above-mentioned portable telephone, and lightweight-izing, and, recently, it may be set as an about [3.6-6V] electrical potential difference. For this reason, the supply voltage of a linear amplifier is also set as about 3.0-6V. Moreover, in order that it may be determined with supply voltage and the output impedance of an amplifier (it is [a transistor a field-effect transistor, and] GaAs-FET also in it especially recently), for example, saturation power may give allowances in

the linear power amplifier whose rated output power is about 1W, as for the saturation power (the power which an input is also increased and does not gain in an output above is said) of the above-mentioned linear amplifier, it is common to set up before and after 2W.
[0008]
[Problem(s) to be Solved by the Invention] However, when it considers as the above-mentioned low supply voltage, as shown in drawing 9 , the output impedance Zo of the output amplifier 24 is set to about 2-6ohms, and becomes quite low compared with the output impedance of the linear amplifier set as usual 50 ohms. In order to change such a low impedance into 50 ohms, it is necessary to adopt the large output matching circuit 25 of an impedance-conversion ratio, and while the loss in a conversion circuit increases for this reason, the frequency range where good adjustment is made becomes narrow. Consequently, there is a problem of becoming the effectiveness of power amplifier and the factor which degrades a clock frequency band.
[0009] This invention was made in view of the above-mentioned actual condition, can avoid increase of loss in the case of setting it as low supply voltage, and the narrow-band of a frequency, and aims at offering the non-reciprocal circuit component and compound electronic parts which can contribute to a miniaturization and low-pricing.
[0010]
[Means for Solving the Problem] It is characterized by setting the input and output impedance Zio of any one port of the above-mentioned center electrode as 2<Zio<12.5ohm in the non-reciprocal circuit component it was made to impress a direct-current field while invention of claim 1 makes two or more center electrodes cross, is arranged and arranges a ferrite to a part for this intersection.
[0011] In the same non-reciprocal circuit component as claim 1, invention of claim 2 adds an impedance-conversion circuit to any one port of the above-mentioned center electrode, and is characterized by setting the input impedance Zi of this port as 2<Zi<12.5ohm.
[0012] Invention of claim 3 is characterized by having connected the terminator to one of the remaining ports where the above-mentioned impedance-conversion circuit is not added, and considering as an isolator in claim 2.
[0013] Invention of claim 4 is characterized by the above-mentioned impedance-conversion circuit being constituted by pi mold network of C-L-C in claim 2 or 3.
[0014] Invention of claim 5 is characterized by being set up so that the cut off frequency fc of pi mold network of above-mentioned C-L-C may serve as 0.75xfo<fc<2xfo in claim 4.
[0015] Invention of claim 6 is characterized by the above-mentioned impedance-conversion circuit being constituted by pi mold network of L-C-L in claim 2 or 3.
[0016] Invention of claim 7 is characterized by the above-mentioned impedance-conversion circuit being constituted by the distributed constant transformer of -(2n-1) lambdag / 4 (n is the natural number and lambdag is the wavelength within a track) in claim 2 or 3.
[0017] The magnetic assembly which comes to arrange a ferrite to a part for this intersection while invention of claim 8 makes two or more center electrodes cross in York which constitutes a magnetic circuit and arranging it, In the non-reciprocal circuit component which contained the capacitor for adjustment connected to the port of each above-mentioned center electrode While adding an impedance-conversion circuit to any one port of the above-mentioned center electrode, it builds in above-mentioned York, and it is characterized by setting the input impedance Zi of this port as 2<Zi<12.5ohm.
[0018] Invention of claim 9 is characterized by forming the above-mentioned impedance-conversion circuit in the non-reciprocal circuit component part arranged in York in claim 8.
[0019] Invention of claim 10 is compound electronic parts characterized by connecting claim 1 thru/or which non-reciprocal circuit component of 9 to the output section of transmitted power amplifier, containing in one case, and having a terminal for surface mounts, and operating with the supply voltage of 6 volts or less.
[0020] In the above-mentioned input impedance Zi here like the input port of an isolator The port concerned means the characteristic impedance of the port usually expected to receive power as the function. In an output impedance Zo It is the semantics of the characteristic impedance of the port usually expected for the port concerned to send out power like the output port of amplifier as the function. Furthermore in an input and an output impedance Zio, it is the semantics of the characteristic impedance of the port from which both the port concerned receiving power and the thing to send out are usually expected as the function like the input/output port of a circulator..
[0021]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained based on an accompanying drawing. Drawing 1 and drawing 2 are drawings for explaining the isolator by claims 1, 2, 3, and 4 and 1 operation gestalt of invention of five, and it is the block diagram of the transmitted power amplifier for cellular phones with which, as for drawing 1 , the representative circuit schematic of an isolator was adopted, and, as for drawing 2 , this isolator was adopted.

[0022] the concentrated-constant mold isolator 1 of this operation gestalt -- three center electrodes 2, 3, and 4 -- mutual -- an electrical machinery-insulation condition -- and while making it cross so that a predetermined include angle may be made, arranging and arranging a ferrite 5 to a part for this intersection, the direct-current field HDC is impressed with a permanent magnet (un-illustrating), and it is constituted.

[0023] Between each above-mentioned center electrodes 2-4 and each ports P1-P3, parallel connection of the capacity C1-C3 for adjustment is carried out, among these the terminator machine R is connected to one port P3. This transmits the sending signal from a port P1 to a port P2, and the reflected wave which invades from this port P2 is absorbed with the terminator vessel R.

[0024] And the impedance-conversion circuit 6 is added to the above-mentioned port P1. Only the impedance of the above-mentioned port P1 is set as 2-12.5ohm by this impedance-conversion circuit 6, and the impedance of a port P2 is set as 50 ohms. The above-mentioned impedance-conversion circuit 6 is built in in the isolator 1 at one.

[0025] The above-mentioned impedance-conversion circuit 6 consists of a C-L-Cpi mold network of an inductance L and Capacitor C, and the cut off frequency fc of this pi mold network is set up so that it may become the range of 0.75xfo<fc<2xfo.

[0026] Moreover, the above-mentioned isolator 1 is inserted between the transmitted power amplifier 10 and an antenna 11. This power amplifier 10 is equipped with input matching circuit [the 12 or 1st step of] amplifier 13, interstage matching circuit [the 14 or 2nd step of] amplifier 15, and the output matching circuit 16, and the above-mentioned isolator 1 is connected to the output section of this output matching circuit 16.

[0027] Next, the operation effectiveness of this operation gestalt is explained. Since according to the isolator 1 of this operation gestalt the impedance-conversion circuit 6 was added to the port P1 where a sending signal is inputted and the impedance was set as 2-12.5ohm, it becomes possible to change the low impedance from the output amplifier 15 into the stable impedance.

[0028] The output matching circuit 16 which it becomes unnecessary to prepare the large matching circuit of an above-mentioned impedance-conversion ratio by this, and removes only a reactance component is employable. Consequently, while being able to make small the insertion loss in the case of setting it as the low supply voltage of 3-6 volts, a frequency band can be made large and the dependability over quality can be improved. As a result, it can contribute to the miniaturization of a portable telephone, and lightweight-ization.

[0029] With this operation gestalt, since the cut off frequency fc of the impedance-conversion circuit 6 was made into the range of 0.75xfo<fc<2xfo, this will function as a low pass filter, the derepression of the unnecessary higher harmonic generated with the transmitted power amplifier 10 can be carried out, and it can contribute to dependability and high performance-ization also from this point.

[0030] In addition, with the above-mentioned operation gestalt, although explained taking the case of the concentrated-constant mold isolator 1, as this invention is shown in drawing 3 , of course, it can apply also to the circulator 40 of 3 port molds, and the same effectiveness as the above-mentioned operation gestalt is acquired by adding the impedance-conversion circuit 6 to any one port P1 also in this case.

[0031] Drawing 4 is a representative circuit schematic for explaining the circulator by 1 operation gestalt of invention of claim 6, and shows that the same sign as drawing 1 is the same, or a considerable part among drawing.

[0032] The direct-current field HDC is impressed and the concentrated-constant mold circulator 41 of this operation gestalt is constituted while arranging a ferrite 5 to a part for the intersection of three center electrodes 2-4. And the impedance-conversion circuit 42 is added to one port P1 of the above-mentioned circulator 41, and this impedance-conversion circuit 42 consists of a pi mold network of L-C-L.

[0033] Also in this operation gestalt, it becomes possible to change a low impedance into the stable impedance, and the same effectiveness as the above-mentioned operation gestalt is acquired.

[0034] Drawing 5 is a representative circuit schematic for explaining the circulator by 1 operation gestalt of invention of claim 7, and shows that the same sign as drawing 1 is the same, or a considerable part among drawing.

[0035] The circulator 41 of this operation gestalt is the case where added the impedance-conversion circuit 43 to one

port P1, and the distributed constant transformer of -(2n-1) lambdag/4 constitutes this conversion circuit 43. Also in this operation gestalt, the same effectiveness as the above-mentioned operation gestalt is acquired.
[0036] Drawing 6 and drawing 7 are drawings for explaining the compound electronic parts by 1 operation gestalt of invention of claim 10, and show that the same sign as drawing 1 and drawing 2 is the same, or a considerable part among drawing.
[0037] The isolator 1 of this operation gestalt comes to add the impedance-conversion circuit 6 to a port P1, and the fundamental structure of it is the same as the above-mentioned operation gestalt. And this isolator 1 is built in at one in the transmitted power amplifier 50 which operates with the supply voltage of 6 volts or less.
[0038] The above-mentioned transmitted power amplifier 50 mounts input matching circuit [the 12 or 1st step of] amplifier 13, above-mentioned interstage matching circuit [the 14 or 2nd step of] amplifier 15, and the above-mentioned output matching circuit 16 in the circuit board 51, and comes to connect each components 12-16 by the microstrip line 54, and the above-mentioned isolator 1 is connected to the output section of this output matching circuit 16.
[0039] Moreover, the above-mentioned circuit board 51 is equipped with the shielding case 52, and the I/O for surface mounts and a grounding terminal 53 have projected from between this case 52 and the circuit boards 51.
[0040] With this operation gestalt, while being able to simplify circuitry since the isolator 1 was built in and it unified in the transmitted power amplifier 50, and it can constitute as one compound electronic parts, it can miniaturize and can contribute to the miniaturization of a portable telephone.
[0041] Here, sheet metal-ization of the circuit board is progressing with the miniaturization of a portable telephone in recent years etc., and lightweight-izing, and the Rhine width of face of a microstrip line also becomes extremely narrow to this. For example, the Rhine width of face with a characteristic impedance [at the time of the Rhine width of face with a characteristic impedance / at the time of setting board thickness of the circuit board to 0.1mm / of 50 ohms being set to 0.17mm, and setting board thickness to 0.3mm] of 50 ohms is set to 0.5mm.
[0042] Thus, if the Rhine width of face becomes narrow, since the width-of-face precision of a MAKUI loss trip line is not acquired, poor adjustment may be caused and it is necessary to make the mounting pad for soldering broad to the above-mentioned Rhine width of face, the problem of causing the poor adjustment in this mounting pad arises. If the Rhine width of face furthermore becomes narrow, transmission loss will also become large so much.
[0043] On the other hand, when a characteristic impedance is set as 2-12.5ohm like this operation gestalt, irrespective of sheet-metal-izing of the circuit board 51, it becomes possible to make large Rhine width of face of a microstrip line 54, and the problem of above-mentioned poor adjustment and the problem of transmission loss can be solved. Moreover, since it is avoidable to cause poor adjustment even if broad in the mounting pad 55 for soldering, aggravation of mounting nature, such as a faulty connection by location gap of the isolator 1 at the time of performing a surface mount, can be prevented, and connection resilience can be improved.
[0044] The productivity of communication equipment etc. and robustness can be improved by this, as a result it is cheap, and a reliable transmitter can be offered. In addition, also in the case of the transmission lines, such as not the thing restricted to the above-mentioned microstrip line but a stripline track, a KOPURENA track, and a Gran dead KOPURENA track, it is the same.
[0045] Moreover, since the isolator 1 was built in in the above-mentioned power amplifier 50 when changing by signals other than the characteristic impedance of 50ohms, a user does not need to treat the part of an un-50-ohm system directly, for example, and time and effort, such as a design change, can be made unnecessary.
[0046] Drawing 10 thru/or drawing 14 are drawings for explaining the non-reciprocal circuit component by claim 8 and 1 operation gestalt of invention of nine. This operation gestalt explains the concrete structure of the isolator which built in the above-mentioned impedance-conversion circuit. The same sign as drawing 1 shows the same or a considerable part among drawing.
[0047] While 1 is a concentrated-constant mold isolator connected to the transmitted power amplification section of migration communication equipment in drawing and this sticks the rectangle-like permanent magnet 61 on the inside of box-like upper York 60 which consists of a magnetic-substance metal While equipping with bottom York 62 which consists of a magnetic-substance metal as well as this upper York 61, forming a magnetic closed circuit and arranging the resin case 63 on base 62a of bottom York 62 of this The magnetic assembly 64 is arranged in this resin case 63, and it is constituted so that a direct-current field may be impressed to this magnetic assembly 64 with the above-mentioned permanent magnet 61.

[0048] It is the thing of the structure which contacted the base of a ferrite 4 in the ground section 7 by the side of the other end while bending, arranging the above-mentioned magnetic assembly 64 so that an insulation sheet (un-illustrating) may be made for three center electrodes 2, 3, and 4 to intervene on the top face of the disc-like ferrite 5 and it may cross for every include angle 120 degrees, and projecting the input/output port P1, P2, and P3 by the side of the end of each center electrodes 2-4 in the method of outside.
[0049] It is the thing of the structure which the above-mentioned resin case 63 consisted of an electric insulating member, and really formed bottom wall 63b in rectangle frame-like side-attachment-wall 63a. Insertion hole 63c is formed in this bottom wall 63b, and 63d of crevices which carry out the positioning receipt of each capacitors C1-C3 for veneer mold adjustment, respectively, and crevice which carries out the positioning receipt of veneer mold terminator R 63e are formed in the periphery section of insertion hole 63c of this bottom wall 63b. The magnetic assembly 64 is inserted in above-mentioned insertion hole 63a, and the ground section 7 of this magnetic assembly 64 is connected to base 62a of bottom York 62.
[0050] Left of the above-mentioned resin case 63, Input/output terminals 66 and 67 are arranged in the end side of right-hand side wall 63a external surface, and the extended edge of each of these input/output terminals 66 and 67 is the left on the top face of bottom wall 63a, It has exposed to the right corner section. Left, Grounding terminals 68 and 68 are arranged in the other end side of right-hand side wall 63a external surface, it exposes to the top face of the above-mentioned crevices 63d and 63e, and the extended edge of each of this grounding terminal 68 is connected to each capacitors C1-C3 and the inferior-surface-of-tongue electrode of Terminator R. Moreover, the piece 69 of a metallic conductor is arranged in the pars intermedia of the input/output terminals 66 and 67 on the above-mentioned top face of bottom wall 63b, it exposes to bottom wall 63b, and the extended edge of this piece 69 of a metallic conductor is connected to base 62a of bottom York 62. In the resin case 63, the above-mentioned input/output terminals 66 and 67, a grounding terminal 68, and the piece 69 of a metallic conductor carry out the insertion mold of the part, and are formed.

[0051] The ports P1-P3 of each center electrodes 2-4 are connected to the top-face electrode of each above-mentioned capacitors C1-C3 for adjustment, among these the tip of a port P2 is connected to the above-mentioned input/output terminal 66, and the tip of a port P3 is connected to Terminator R.
[0052] The rectangle tabular spacing member 70 is arranged between the above-mentioned magnetic assembly 64 and the permanent magnet 61. This spacing member 70 consists of resin, such as a liquid crystal polymer which has printed circuit boards, such as a glass epoxy system, a plastics system, and a Teflon system, a ceramic substrate, or elasticity, and hole 70a is formed in the center section. This hole 70a is for pressing effectively, and necessarily needs to form neither the capacitors C1-C3 for adjustment, nor center electrodes 2-4.
[0053] Through the permanent magnet 61, the ports P1-P3 of each center electrodes 2-4 are carried out in bottom York 62, and the above-mentioned spacing member 70 is carrying out press immobilization of these each capacitors C1-C3 for adjustment, and the terminator R for the magnetic assembly 64 and the resin case 63 respectively electrically [the resin case 63] and mechanically at the capacitors C1-C3 for adjustment, and Terminator R at the same time it fits upper York 60 in bottom York 62. Poor opening at the time of being able to make unnecessary the exclusive fixture at the time of this soldering each component parts, and becoming reducible [an activity man day], and carrying out a surface mount by the user reflow is prevented.
[0054] And as shown in drawing 3 (a) and drawing 3 (b), the impedance-conversion circuit 6 which consists of a pi mold network of C-L-C is formed in the above-mentioned spacing member 70. This impedance-conversion circuit 6 carries out pattern formation of the inductance electrode 71 and the 1st and 2nd capacitor electrodes 72 and 73 to a spacing member 70 by sticking by pressure, printing, etc., and is constituted. In addition, in a spacing member, the above-mentioned electrodes 71-73 may carry out the insertion mold of the piece of a metal, and may form it. Here, drawing 3 (a) is the top view showing the electrode formed in the top face of a spacing member 70, and drawing 3 (b) is the top view having shown the electrode formed in the inferior surface of tongue of a spacing member 70 by fluoroscopy.
[0055] End section 71a of the above-mentioned inductance electrode 71 is connected to the through hole electrode 74, and other end 71b is connected to end section 72a of the above-mentioned 1st capacitor electrode 72. Other end 72b of this 1st capacitor electrode 72 is connected to the through hole electrode 75.
[0056] The 2nd capacitor electrode 73 which counters the above-mentioned 1st capacitor electrode 72 on both sides of this member 70 is formed in the inferior surface of tongue of the above-mentioned spacing member 70, and connection

formation of the 1st connection electrode 76 which counters the connection of the above-mentioned other end 71b and end section 72a following this 2nd capacitor electrode 73 is carried out.
[0057] Moreover, the 2nd connection electrode 77 is formed in the part which counters other end 72b of the 1st capacitor electrode 72 of the spacing member 70 above-mentioned inferior surface of tongue, and two electrodes 72b and 77 are connected by the above-mentioned through hole electrode 75. The 3rd connection electrode 78 is formed in the part which furthermore counters end section 71a of the inductance electrode 71 of the spacing member 70 above-mentioned inferior surface of tongue, and two electrodes 71a and 78 are connected by the above-mentioned through hole electrode 74.
[0058] The above-mentioned 1st connection electrode 76 is connected to bottom York 62 through the piece 69 of a metallic conductor, the 2nd connection electrode 77 is connected to the input/output terminal 67 of one side, and the 3rd connection electrode 78 is connected to the port P1 of a center electrode 2, and the top-face electrode of the capacitor C1 for adjustment.
[0059] Thus, as the isolator 1 of this operation gestalt is shown in the representative circuit schematic of drawing 13 and drawing 14 , parallel connection of the capacitor Cf1 in which the series connection of the inductance Lf formed with the inductance electrode 71 is carried out between the port P1 of a center electrode 2 and an input/output terminal 67, and it is formed with the 1st and 2nd capacitor electrodes 72 and 73 through the 1st capacitor electrode 72 is carried out between the input/output terminal 67 and the piece 69 (ground) of a metallic conductor.
[0060] And the capacitor C1 for adjustment of the above-mentioned port P1 is expressed with the juxtaposition capacity of the capacitor Co which functions as a circuit for adjustment of isolator original, and a capacitor Cf2, and the impedance-conversion circuit 6 of C-L-C consists of this capacitor Cf2, inductance Lf, and capacitor Cf1.
[0061] Since according to this operation gestalt the impedance-conversion circuit 6 was added to the port P1 and this impedance was set as 2-12.5ohm, it becomes possible to change a low impedance into the stable impedance like ****, and while being able to make small the insertion loss in the case of setting it as low supply voltage, a frequency band can be made large and the same effectiveness as the above-mentioned operation gestalt is acquired.
[0062] Since the impedance-conversion circuit 6 was formed in the spacing member 70 which is the component part of the above-mentioned isolator 1, this impedance-conversion circuit 6 can be built in an isolator 1, and the rise of the components cost in the case of preparing a conversion circuit separately and enlargement can be avoided, as a result it can contribute to the miniaturization of migration communication equipment, and low-pricing. Moreover, since the above-mentioned spacing member 70 was used effectively and formed, the dimension of an isolator does not become large and it can contribute to a miniaturization and lightweight-ization also from this point.
[0063] in addition, what is necessary is not to restrict this invention to this, to look it like [other substrates which constitute the non-reciprocal circuit arranged in York, or components], and just to form it, although the case where an impedance-conversion circuit was formed in a spacing member was taken for the example with the above-mentioned operation gestalt
[0064]
[Effect of the Invention] Since the input and output impedance Zio of any one port of a center electrode were set as 2<Zio<12.5ohm according to the non-reciprocal circuit component which starts invention of claim 1 as mentioned above Since it becomes possible to change a low impedance into the stable impedance and it becomes unnecessary to prepare the large matching circuit of an impedance-conversion ratio, while being able to make small the insertion loss in the case of setting it as low supply voltage A frequency band can be made large and there is effectiveness which can improve the dependability over quality.
[0065] In invention of claim 2, since the impedance-conversion circuit was added to any one port of the center electrode and the input impedance Zi was set as 2<Zi<12.5ohm, it can change into the impedance stabilized like the above, and the same effectiveness as claim 1 is acquired.
[0066] In invention of claim 3, since the terminator was connected to the one remaining ports where the impedance-conversion circuit is not added, it will function as an isolator and there is an improvement effect of the adjustment condition in the transmitted power amplifier of a portable telephone.
[0067] [0068] from which the same effectiveness as above-mentioned claim 1 is acquired since pi mold network of C-L-C constituted the above-mentioned impedance-conversion circuit from invention of claim 4 In invention of claim 5, since the cut off frequency fc of the above-mentioned C-L-Cpi mold network was made into the range of 0.75xfo<fc<2xfo, it will function as a low pass filter, the derepression of the unnecessary higher harmonic generated

with transmitted power amplifier can be carried out, and there are dependability and effectiveness that it can contribute to high performance-ization.
[0069] In invention of claim 6, since pi mold network of L-C-L constituted the above-mentioned impedance-conversion circuit, the same effectiveness as above-mentioned claim 1 is acquired.
[0070] In invention of claim 7, since the above-mentioned impedance-conversion circuit was constituted to the distributed constant transformer of -(2n-1) lambdag / 4 (n is the natural number and lambdag is the wavelength within a track), the same effectiveness as above-mentioned claim 1 is acquired.
[0071] In invention of claim 8, since the impedance-conversion circuit was built in in York, the cost rise and enlargement in the case of using another circuit can be avoided, and it is effective in the ability to contribute to a miniaturization and low-pricing.
[0072] In invention of claim 9, since the impedance-conversion circuit was formed in the non-reciprocal circuit component part arranged in York, these components can be used effectively and formed and it is effective in the ability to contribute to a miniaturization and lightweight-ization.
[0073] In invention of claim 10, since the non-reciprocal circuit component was built in at one in the transmitted power amplifier which operates with the supply voltage of 6 volts or less, while being able to simplify circuitry, it is effective in the ability to contribute to a miniaturization, and the Rhine width of face can be set up widely and it is effective in the ability to prevent generating of poor adjustment.

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PRIOR ART

[Description of the Prior Art] Recently, in the field of migration communication equipment, such as a portable telephone, the communication equipment which adopted the digital modulation method with high band use effectiveness, such as 1/4piQPSK, and CDMA, is being adopted. In this digital communication device, as shown in drawing 9 , the linear amplifier 20 is adopted as the transmitted power amplification section. This has structure which carried out connecting arrangement of input matching circuit [the 21 or 1st step of] amplifier 22, interstage matching circuit [the 23 or 2nd step of] amplifier 24, and the output matching circuit 25.
[0003] If in charge of adopting such a linear amplifier 20, since it has effect to the time amount of the portable telephone by cell actuation which can be communicated with the big power consumption in the power amplification section, technical amelioration when attaining efficient-ization is progressing remarkably.
[0004] By the way, the above-mentioned efficient linear amplifier has the property of being easy to be influenced of change by load impedance. Namely, only in a fixed case, efficient-ization of magnification is demonstrated with a value with desirable load impedance. For example, if change of an input impedance carries out direct continuation of the large load to the above-mentioned linear amplifier like an antenna, the problem that the effectiveness of amplifier falls or I/O linearity deteriorates will arise. Consequently, the power consumption in the transmitted power amplification section increases, discharge of a cell may progress, the time amount which can be communicated may become short, and distortion may arise in a transmission wave, and an interference may be generated in an adjacent channel and a contiguity frequency. There is a possibility that may become recovery impossible by the receiving side and the transmission itself may furthermore become impossible for modulation distortion.
[0005] In order to solve such a problem, the isolator 27 of a concentrated-constant mold may be inserted between the above-mentioned linear amplifier 20 and an antenna 26. As shown in drawing 8 , while this isolator makes three center electrodes 30-32 cross for every predetermined spacing mutually, is arranged and arranges a ferrite 33 to a part for this intersection, it is constituted so that the direct-current field HDC may be impressed, and Terminator R is connected to the port P3 of the above-mentioned center electrode 32.
[0006] Since the input impedance is stable irrespective of change of load impedance, the above-mentioned isolator 27 has the function to absorb the reflection from an antenna and to improve an adjustment condition. This has prevented the decline in the effectiveness of the above-mentioned linear amplifier, or degradation of I/O linearity. Moreover, as for the characteristic impedance of the input of the above-mentioned linear amplifier 20, and an output, designing by 50 ohms is common, also in the isolator 27, generally the input impedance is set as 50 ohms, and this serves as a certified value in RF components.
[0007] On the other hand, simplification of a cell configuration is also progressing with the miniaturization of the above-mentioned portable telephone, and lightweight-izing, and, recently, it may be set as an about [3.6-6V] electrical potential difference. For this reason, the supply voltage of a linear amplifier is also set as about 3.0-6V. Moreover, in order that it may be determined with supply voltage and the output impedance of an amplifier (it is [a transistor a field-effect transistor, and] GaAs-FET also in it especially recently), for example, saturation power may give allowances in the linear power amplifier whose rated output power is about 1W, as for the saturation power (the power which an input is also increased and does not gain in an output above is said) of the above-mentioned linear amplifier, it is common to set up before and after 2W.

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TECHNICAL FIELD

[Field of the Invention] This invention relates to the isolator of the non-reciprocal circuit component used with a microwave band, for example, a concentrated-constant mold, and a circulator.

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EFFECT OF THE INVENTION

[Effect of the Invention] In the non-reciprocal circuit component of invention of claim 1, the input and output impedance Zio of any one port of a center electrode were set as 2<Zio<12.5ohm as mentioned above. Therefore, since it becomes possible to change a low impedance into the stable impedance and it becomes unnecessary to prepare the large matching circuit of an impedance-conversion ratio, while being able to make small the insertion loss in the case of setting it as low supply voltage, a frequency band can be made large and there is effectiveness which can improve the dependability over quality.
[0065] In invention of claim 2, since the impedance-conversion circuit was added to any one port of the center electrode and the input impedance Zi was set as 2<Zi<12.5ohm, it can change into the impedance stabilized like the above, and the same effectiveness as claim 1 is acquired.
[0066] In invention of claim 3, since the terminator was connected to the one remaining ports where the impedance-conversion circuit is not added, it will function as an isolator and there is an improvement effect of the adjustment condition in the transmitted power amplifier of a portable telephone.
[0067] In invention of claim 4, since pi mold network of C-L-C constituted the above-mentioned impedance-conversion circuit, the same effectiveness as above-mentioned claim 1 is acquired. [0068] In invention of claim 5, since the cut off frequency fc of the above-mentioned C-L-Cpi mold network was made into the range of 0.75xfo<fc<2xfo, it will function as a low pass filter, the derepression of the unnecessary higher harmonic generated with transmitted power amplifier can be carried out, and there are dependability and effectiveness that it can contribute to high performance-ization.
[0069] In invention of claim 6, since pi mold network of L-C-L constituted the above-mentioned impedance-conversion circuit, the same effectiveness as above-mentioned claim 1 is acquired.
[0070] In invention of claim 7, since the above-mentioned impedance-conversion circuit was constituted to the distributed constant transformer of -(2n-1) lambdag / 4 (n is the natural number and lambdag is the wavelength within a track), the same effectiveness as above-mentioned claim 1 is acquired.
[0071] In invention of claim 8, since the impedance-conversion circuit was built in in York, the cost rise and enlargement in the case of using another circuit can be avoided, and it is effective in the ability to contribute to a miniaturization and low-pricing.
[0072] In invention of claim 9, since the impedance-conversion circuit was formed in the non-reciprocal circuit component part arranged in York, these components can be used effectively and formed and it is effective in the ability to contribute to a miniaturization and lightweight-ization.
[0073] In invention of claim 10, since the non-reciprocal circuit component was built in at one in the transmitted power amplifier which operates with the supply voltage of 6 volts or less, while being able to simplify circuitry, it is effective in the ability to contribute to a miniaturization, and the Rhine width of face can be set up widely and it is effective in the ability to prevent generating of poor adjustment.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, when it considers as the above-mentioned low supply voltage, as shown in drawing 9 , the output impedance Zo of the output amplifier 24 is set to about 2-6ohms, and becomes quite low compared with the output impedance of the linear amplifier set as usual 50 ohms. In order to change such a low impedance into 50 ohms, it is necessary to adopt the large output matching circuit 25 of an impedance-conversion ratio, and while the loss in a conversion circuit increases for this reason, the frequency range where good adjustment is made becomes narrow. Consequently, there is a problem of becoming the effectiveness of power amplifier and the factor which degrades a clock frequency band.
[0009] This invention was made in view of the above-mentioned actual condition, can avoid increase of loss in the case of setting it as low supply voltage, and the narrow-band of a frequency, and aims at offering the non-reciprocal circuit component and compound electronic parts which can contribute to a miniaturization and low-pricing.

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MEANS

[Means for Solving the Problem] It is characterized by setting the input and output impedance Zio of any one port of the above-mentioned center electrode as 2<Zio<12.5ohm in the non-reciprocal circuit component it was made to impress a direct-current field while invention of claim 1 makes two or more center electrodes cross, is arranged and arranges a ferrite to a part for this intersection.
[0011] In the same non-reciprocal circuit component as claim 1, invention of claim 2 adds an impedance-conversion circuit to any one port of the above-mentioned center electrode, and is characterized by setting the input impedance Zi of this port as 2<Zi<12.5ohm.
[0012] Invention of claim 3 is characterized by having connected the terminator to one of the remaining ports where the above-mentioned impedance-conversion circuit is not added, and considering as an isolator in claim 2.
[0013] Invention of claim 4 is characterized by the above-mentioned impedance-conversion circuit being constituted by pi mold network of C-L-C in claim 2 or 3.
[0014] Invention of claim 5 is characterized by being set up so that the cut off frequency fc of pi mold network of above-mentioned C-L-C may serve as 0.75xfo<fc<2xfo in claim 4.
[0015] Invention of claim 6 is characterized by the above-mentioned impedance-conversion circuit being constituted by pi mold network of L-C-L in claim 2 or 3.
[0016] Invention of claim 7 is characterized by the above-mentioned impedance-conversion circuit being constituted by the distributed constant transformer of -(2n-1) lambdag / 4 (n is the natural number and lambdag is the wavelength within a track) in claim 2 or 3.
[0017] The magnetic assembly which comes to arrange a ferrite to a part for this intersection while invention of claim 8 makes two or more center electrodes cross in York which constitutes a magnetic circuit and arranging it, In the non-reciprocal circuit component which contained the capacitor for adjustment connected to the port of each above-mentioned center electrode While adding an impedance-conversion circuit to any one port of the above-mentioned center electrode, it builds in above-mentioned York, and it is characterized by setting the input impedance Zi of this port as 2<Zi<12.5ohm.
[0018] Invention of claim 9 is characterized by forming the above-mentioned impedance-conversion circuit in the non-reciprocal circuit component part arranged in York in claim 8.
[0019] Invention of claim 10 is compound electronic parts characterized by connecting claim 1 thru/or which non-reciprocal circuit component of 9 to the output section of transmitted power amplifier, containing in one case, and having a terminal for surface mounts, and operating with the supply voltage of 6 volts or less.
[0020] In the above-mentioned input impedance Zi here like the input port of an isolator The port concerned means the characteristic impedance of the port usually expected to receive power as the function. In an output impedance Zo It is the semantics of the characteristic impedance of the port usually expected for the port concerned to send out power like the output port of amplifier as the function. Furthermore in an input and an output impedance Zio, it is the semantics of the characteristic impedance of the port from which both the port concerned receiving power and the thing to send out are usually expected as the function like the input/output port of a circulator.
[0021]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained based on an accompanying drawing. Drawing 1 and drawing 2 are drawings for explaining the isolator by claims 1, 2, 3, and 4 and 1 operation gestalt of invention of five, and it is the block diagram of the transmitted power amplifier for cellular

phones with which, as for drawing 1 , the representative circuit schematic of an isolator was adopted, and, as for drawing 2 , this isolator was adopted.
[0022] the concentrated-constant mold isolator 1 of this operation gestalt -- three center electrodes 2, 3, and 4 -- mutual -- an electrical machinery-insulation condition -- and while making it cross so that a predetermined include angle may be made, arranging and arranging a ferrite 5 to a part for this intersection, the direct-current field HDC is impressed with a permanent magnet (un-illustrating), and it is constituted.
[0023] Between each above-mentioned center electrodes 2-4 and each ports P1-P3, parallel connection of the capacity C1-C3 for adjustment is carried out, among these the terminator machine R is connected to one port P3. This transmits the sending signal from a port P1 to a port P2, and the reflected wave which invades from this port P2 is absorbed with the terminator vessel R.
[0024] And the impedance-conversion circuit 6 is added to the above-mentioned port P1. Only the impedance of the above-mentioned port P1 is set as 2-12.5ohm by this impedance-conversion circuit 6, and the impedance of a port P2 is set as 50 ohms. The above-mentioned impedance-conversion circuit 6 is built in in the isolator 1 at one.
[0025] The above-mentioned impedance-conversion circuit 6 consists of a C-L-Cpi mold network of an inductance L and Capacitor C, and the cut off frequency fc of this pi mold network is set up so that it may become the range of 0.75xfo<fc<2xfo.
[0026] Moreover, the above-mentioned isolator 1 is inserted between the transmitted power amplifier 10 and an antenna 11. This power amplifier 10 is equipped with input matching circuit [the 12 or 1st step of] amplifier 13, interstage matching circuit [the 14 or 2nd step of] amplifier 15, and the output matching circuit 16, and the above-mentioned isolator 1 is connected to the output section of this output matching circuit 16.
[0027] Next, the operation effectiveness of this operation gestalt is explained. Since according to the isolator 1 of this operation gestalt the impedance-conversion circuit 6 was added to the port P1 where a sending signal is inputted and the impedance was set as 2-12.5ohm, it becomes possible to change the low impedance from the output amplifier 15 into the stable impedance.
[0028] The output matching circuit 16 which it becomes unnecessary to prepare the large matching circuit of an above-mentioned impedance-conversion ratio by this, and removes only a reactance component is employable. Consequently, while being able to make small the insertion loss in the case of setting it as the low supply voltage of 3-6 volts, a frequency band can be made large and the dependability over quality can be improved. As a result, it can contribute to the miniaturization of a portable telephone, and lightweight-ization.
[0029] With this operation gestalt, since the cut off frequency fc of the impedance-conversion circuit 6 was made into the range of 0.75xfo<fc<2xfo, this will function as a low pass filter, the derepression of the unnecessary higher harmonic generated with the transmitted power amplifier 10 can be carried out, and it can contribute to dependability and high performance-ization also from this point.
[0030] In addition, with the above-mentioned operation gestalt, although explained taking the case of the concentrated-constant mold isolator 1, as this invention is shown in drawing 3 , of course, it can apply also to the circulator 40 of 3 port molds, and the same effectiveness as the above-mentioned operation gestalt is acquired by adding the impedance-conversion circuit 6 to any one port P1 also in this case.
[0031] Drawing 4 is a representative circuit schematic for explaining the circulator by 1 operation gestalt of invention of claim 6, and shows that the same sign as drawing 1 is the same, or a considerable part among drawing.
[0032] The direct-current field HDC is impressed and the concentrated-constant mold circulator 41 of this operation gestalt is constituted while arranging a ferrite 5 to a part for the intersection of three center electrodes 2-4. And the impedance-conversion circuit 42 is added to one port P1 of the above-mentioned circulator 41, and this impedance-conversion circuit 42 consists of a pi mold network of L-C-L.
[0033] Also in this operation gestalt, it becomes possible to change a low impedance into the stable impedance, and the same effectiveness as the above-mentioned operation gestalt is acquired.
[0034] Drawing 5 is a representative circuit schematic for explaining the circulator by 1 operation gestalt of invention of claim 7, and shows that the same sign as drawing 1 is the same, or a considerable part among drawing.
[0035] The circulator 41 of this operation gestalt is the case where added the impedance-conversion circuit 43 to one port P1, and the distributed constant transformer of -(2n-1) lambdag/4 constitutes this conversion circuit 43. Also in this operation gestalt, the same effectiveness as the above-mentioned operation gestalt is acquired.
[0036] Drawing 6 and drawing 7 are drawings for explaining the compound electronic parts by 1 operation gestalt of

invention of claim 10, and show that the same sign as drawing 1 and drawing 2 is the same, or a considerable part among drawing.
[0037] The isolator 1 of this operation gestalt comes to add the impedance-conversion circuit 6 to a port P1, and the fundamental structure of it is the same as the above-mentioned operation gestalt. And this isolator 1 is built in at one in the transmitted power amplifier 50 which operates with the supply voltage of 6 volts or less.
[0038] The above-mentioned transmitted power amplifier 50 mounts input matching circuit [the 12 or 1st step of] amplifier 13, above-mentioned interstage matching circuit [the 14 or 2nd step of] amplifier 15, and the above-mentioned output matching circuit 16 in the circuit board 51, and comes to connect each components 12-16 by the microstrip line 54, and the above-mentioned isolator 1 is connected to the output section of this output matching circuit 16.
[0039] Moreover, the above-mentioned circuit board 51 is equipped with the shielding case 52, and the I/O for surface mounts and a grounding terminal 53 have projected from between this case 52 and the circuit boards 51.
[0040] With this operation gestalt, while being able to simplify circuitry since the isolator 1 was built in and it unified in the transmitted power amplifier 50, and it can constitute as one compound electronic parts, it can miniaturize and can contribute to the miniaturization of a portable telephone.
[0041] Here, sheet metal-ization of the circuit board is progressing with the miniaturization of a portable telephone in recent years etc., and lightweight-izing, and the Rhine width of face of a microstrip line also becomes extremely narrow to this. For example, the Rhine width of face with a characteristic impedance [at the time of the Rhine width of face with a characteristic impedance / at the time of setting board thickness of the circuit board to 0.1mm / of 50 ohms being set to 0.17mm, and setting board thickness to 0.3mm] of 50 ohms is set to 0.5mm.
[0042] Thus, if the Rhine width of face becomes narrow, since the width-of-face precision of a MAKUI loss trip line is not acquired, poor adjustment may be caused and it is necessary to make the mounting pad for soldering broad to the above-mentioned Rhine width of face, the problem of causing the poor adjustment in this mounting pad arises. If the Rhine width of face furthermore becomes narrow, transmission loss will also become large so much.
[0043] On the other hand, when a characteristic impedance is set as 2-12.5ohm like this operation gestalt, irrespective of sheet-metal-izing of the circuit board 51, it becomes possible to make large Rhine width of face of a microstrip line 54, and the problem of above-mentioned poor adjustment and the problem of transmission loss can be solved. Moreover, since it is avoidable to cause poor adjustment even if broad in the mounting pad 55 for soldering, aggravation of mounting nature, such as a faulty connection by location gap of the isolator 1 at the time of performing a surface mount, can be prevented, and connection resilience can be improved.
[0044] The productivity of communication equipment etc. and robustness can be improved by this, as a result it is cheap, and a reliable transmitter can be offered. In addition, also in the case of the transmission lines, such as not the thing restricted to the above-mentioned microstrip line but a stripline track, a KOPURENA track, and a Gran dead KOPURENA track, it is the same.
[0045] Moreover, since the isolator 1 was built in in the above-mentioned power amplifier 50 when changing by signals other than the characteristic impedance of 50ohms, a user does not need to treat the part of an un-50-ohm system directly, for example, and time and effort, such as a design change, can be made unnecessary.
[0046] Drawing 10 thru/or drawing 14 are drawings for explaining the non-reciprocal circuit component by claim 8 and 1 operation gestalt of invention of nine. This operation gestalt explains the concrete structure of the isolator which built in the above-mentioned impedance-conversion circuit. The same sign as drawing 1 shows the same or a considerable part among drawing.
[0047] While 1 is a concentrated-constant mold isolator connected to the transmitted power amplification section of migration communication equipment in drawing and this sticks the rectangle-like permanent magnet 61 on the inside of box-like upper York 60 which consists of a magnetic-substance metal While equipping with bottom York 62 which consists of a magnetic-substance metal as well as this upper York 61, forming a magnetic closed circuit and arranging the resin case 63 on base 62a of bottom York 62 of this The magnetic assembly 64 is arranged in this resin case 63, and it is constituted so that a direct-current field may be impressed to this magnetic assembly 64 with the above-mentioned permanent magnet 61.
[0048] It is the thing of the structure which contacted the base of a ferrite 4 in the ground section 7 by the side of the other end while bending, arranging the above-mentioned magnetic assembly 64 so that an insulation sheet (un-illustrating) may be made for three center electrodes 2, 3, and 4 to intervene on the top face of the disc-like ferrite 5 and

it may cross for every include angle 120 degrees, and projecting the input/output port P1, P2, and P3 by the side of the end of each center electrodes 2-4 in the method of outside.
[0049] It is the thing of the structure which the above-mentioned resin case 63 consisted of an electric insulating member, and really formed bottom wall 63b in rectangle frame-like side-attachment-wall 63a. Insertion hole 63c is formed in this bottom wall 63b, and 63d of crevices which carry out the positioning receipt of each capacitors C1-C3 for veneer mold adjustment, respectively, and crevice which carries out the positioning receipt of veneer mold terminator R 63e are formed in the periphery section of insertion hole 63c of this bottom wall 63b. The magnetic assembly 64 is inserted in above-mentioned insertion hole 63a, and the ground section 7 of this magnetic assembly 64 is connected to base 62a of bottom York 62.
[0050] Left of the above-mentioned resin case 63, Input/output terminals 66 and 67 are arranged in the end side of right-hand side wall 63a external surface, and the extended edge of each of these input/output terminals 66 and 67 is the left on the top face of bottom wall 63a, It has exposed to the right corner section. Left, Grounding terminals 68 and 68 are arranged in the other end side of right-hand side wall 63a external surface, it exposes to the top face of the above-mentioned crevices 63d and 63e, and the extended edge of each of this grounding terminal 68 is connected to each capacitors C1-C3 and the inferior-surface-of-tongue electrode of Terminator R. Moreover, the piece 69 of a metallic conductor is arranged in the pars intermedia of the input/output terminals 66 and 67 on the above-mentioned top face of bottom wall 63b, it exposes to bottom wall 63b, and the extended edge of this piece 69 of a metallic conductor is connected to base 62a of bottom York 62. In the resin case 63, the above-mentioned input/output terminals 66 and 67, a grounding terminal 68, and the piece 69 of a metallic conductor carry out the insertion mold of the part, and are formed.

[0051] The ports P1-P3 of each center electrodes 2-4 are connected to the top-face electrode of each above-mentioned capacitors C1-C3 for adjustment, among these the tip of a port P2 is connected to the above-mentioned input/output terminal 66, and the tip of a port P3 is connected to Terminator R.
[0052] The rectangle tabular spacing member 70 is arranged between the above-mentioned magnetic assembly 64 and the permanent magnet 61. This spacing member 70 consists of resin, such as a liquid crystal polymer which has printed circuit boards, such as a glass epoxy system, a plastics system, and a Teflon system, a ceramic substrate, or elasticity, and hole 70a is formed in the center section. This hole 70a is for pressing effectively, and necessarily needs to form neither the capacitors C1-C3 for adjustment, nor center electrodes 2-4.
[0053] Through the permanent magnet 61, the ports P1-P3 of each center electrodes 2-4 are carried out in bottom York 62, and the above-mentioned spacing member 70 is carrying out press immobilization of these each capacitors C1-C3 for adjustment, and the terminator R for the magnetic assembly 64 and the resin case 63 respectively electrically [the resin case 63] and mechanically at the capacitors C1-C3 for adjustment, and Terminator R at the same time it fits upper York 60 in bottom York 62. Poor opening at the time of being able to make unnecessary the exclusive fixture at the time of this soldering each component parts, and becoming reducible [an activity man day], and carrying out a surface mount by the user reflow is prevented.
[0054] And as shown in drawing 3 (a) and drawing 3 (b), the impedance-conversion circuit 6 which consists of a pi mold network of C-L-C is formed in the above-mentioned spacing member 70. This impedance-conversion circuit 6 carries out pattern formation of the inductance electrode 71 and the 1st and 2nd capacitor electrodes 72 and 73 to a spacing member 70 by sticking by pressure, printing, etc., and is constituted. In addition, in a spacing member, the above-mentioned electrodes 71-73 may carry out the insertion mold of the piece of a metal, and may form it. Here, drawing 3 (a) is the top view showing the electrode formed in the top face of a spacing member 70, and drawing 3 (b) is the top view having shown the electrode formed in the inferior surface of tongue of a spacing member 70 by fluoroscopy.
[0055] End section 71a of the above-mentioned inductance electrode 71 is connected to the through hole electrode 74, and other end 71b is connected to end section 72a of the above-mentioned 1st capacitor electrode 72. Other end 72b of this 1st capacitor electrode 72 is connected to the through hole electrode 75.
[0056] The 2nd capacitor electrode 73 which counters the above-mentioned 1st capacitor electrode 72 on both sides of this member 70 is formed in the inferior surface of tongue of the above-mentioned spacing member 70, and connection formation of the 1st connection electrode 76 which counters the connection of the above-mentioned other end 71b and end section 72a following this 2nd capacitor electrode 73 is carried out.
[0057] Moreover, the 2nd connection electrode 77 is formed in the part which counters other end 72b of the 1st

capacitor electrode 72 of the spacing member 70 above-mentioned inferior surface of tongue, and two electrodes 72b and 77 are connected by the above-mentioned through hole electrode 75. The 3rd connection electrode 78 is formed in the part which furthermore counters end section 71a of the inductance electrode 71 of the spacing member 70 above-mentioned inferior surface of tongue, and two electrodes 71a and 78 are connected by the above-mentioned through hole electrode 74.

[0058] The above-mentioned 1st connection electrode 76 is connected to bottom York 62 through the piece 69 of a metallic conductor, the 2nd connection electrode 77 is connected to the input/output terminal 67 of one side, and the 3rd connection electrode 78 is connected to the port P1 of a center electrode 2, and the top-face electrode of the capacitor C1 for adjustment.

[0059] Thus, as the isolator 1 of this operation gestalt is shown in the representative circuit schematic of drawing 13 and drawing 14 , parallel connection of the capacitor Cf1 in which the series connection of the inductance Lf formed with the inductance electrode 71 is carried out between the port P1 of a center electrode 2 and an input/output terminal 67, and it is formed with the 1st and 2nd capacitor electrodes 72 and 73 through the 1st capacitor electrode 72 is carried out between the input/output terminal 67 and the piece 69 (ground) of a metallic conductor.

[0060] And the capacitor C1 for adjustment of the above-mentioned port P1 is expressed with the juxtaposition capacity of the capacitor Co which functions as a circuit for adjustment of isolator original, and a capacitor Cf2, and the impedance-conversion circuit 6 of C-L-C consists of this capacitor Cf2, inductance Lf, and capacitor Cf1.

[0061] Since according to this operation gestalt the impedance-conversion circuit 6 was added to the port P1 and this impedance was set as 2-12.5ohm, it becomes possible to change a low impedance into the stable impedance like ****, and while being able to make small the insertion loss in the case of setting it as low supply voltage, a frequency band can be made large and the same effectiveness as the above-mentioned operation gestalt is acquired.

[0062] Since the impedance-conversion circuit 6 was formed in the spacing member 70 which is the component part of the above-mentioned isolator 1, this impedance-conversion circuit 6 can be built in an isolator 1, and the rise of the components cost in the case of preparing a conversion circuit separately and enlargement can be avoided, as a result it can contribute to the miniaturization of migration communication equipment, and low-pricing. Moreover, since the above-mentioned spacing member 70 was used effectively and formed, the dimension of an isolator does not become large and it can contribute to a miniaturization and lightweight-ization also from this point.

[0063] in addition, what is necessary is not to restrict this invention to this, to look it like [other substrates which constitute the non-reciprocal circuit arranged in York, or components], and just to form it, although the case where an impedance-conversion circuit was formed in a spacing member was taken for the example with the above-mentioned operation gestalt

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[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the representative circuit schematic of the concentrated-constant mold isolator by 1 operation gestalt of invention of claim 1-5.
[Drawing 2] It is the block diagram of the transmitted power amplifier with which the above-mentioned isolator was adopted.
[Drawing 3] It is a representative circuit schematic at the time of applying to a circulator.
[Drawing 4] It is the representative circuit schematic of the concentrated-constant mold circulator by 1 operation gestalt of invention of claim 6.
[Drawing 5] It is the representative circuit schematic of the concentrated-constant mold circulator by 1 operation gestalt of invention of claim 7.
[Drawing 6] It is the block diagram of the transmitted power amplifier (compound electronic parts) which contained the isolator by 1 operation gestalt of invention of claim 10.
[Drawing 7] It is the decomposition perspective view of the above-mentioned transmitted power amplifier.
[Drawing 8] It is the representative circuit schematic of a general isolator.
[Drawing 9] It is the block diagram of common transmitted power amplifier.
[Drawing 10] It is the decomposition perspective view of the concentrated-constant mold isolator by invention of claims 8 and 9.
[Drawing 11] It is the top view of the resin case of the above-mentioned isolator.
[Drawing 12] It is the top view of the spacing member of the above-mentioned isolator.
[Drawing 13] It is the representative circuit schematic of the above-mentioned isolator.
[Drawing 14] It is the circuit diagram of the low pass filter part of the above-mentioned isolator.
[Description of Notations]
1 Isolator (Non-reciprocal Circuit Component)
2-4 Center electrode
5 Ferrite
6, 42, 43 Impedance-conversion circuit
40 41 Circulator (non-reciprocal circuit component)
50 Transmitted Power Amplifier
60 62 A top, bottom York
61 Permanent Magnet
64 Magnetic Assembly
70 Spacing Member (Non-reciprocal Circuit Component Part)
71 Inductance Electrode (Inductance Lf)
72 73 Capacitor electrode (capacitor Cf1)
P1-P3 Port
C1-C3 Capacitor for adjustment

[Translation done.]